Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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2965A
100 kHz to 1 GHz Radio Test Set

A high performance and comprehensive radio test set that provides fast tests for increased throughput

- Fast and accurate radio testing
- High performance, full span spectrum analyzer
- Tracking generator with variable level and offset tracking
- FFT analyzer for audio and modulation signals
- 500 kHz digital storage oscilloscope
- Variable Frequency SINAD/Distortion
- Accurate broadband power meter from 1 mW to 150 W
- Selective power meter with 2 µV sensitivity

The 2965A Radio Test Set builds on the benchmark performance of its 2955 series predecessors by offering superior speed and ease of use. Its benefits include competitive pricing and performance, well proven ergonomics and broad range of applications and options. It boasts many features that are not found in test sets selling for much higher prices. The design allows high speed of operation and accuracy of measurements, resulting in higher throughput and the application of tighter test limits.

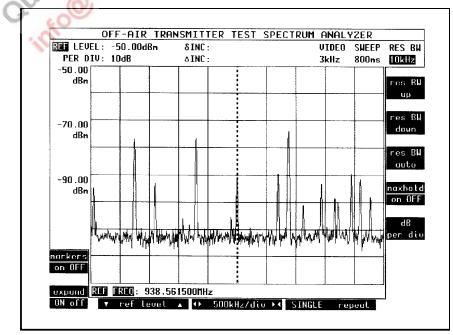
Standard Features

The 2965A Radio Test Set follows the philosophy of offering a complete package with many of the features as standard. Among the standard features of the 2965A Radio Test Set are full span spectrum analyzer, tracking generator, broadband power meter, 500 kHz oscilloscope and a PC compatible memory card with internal autorun capability.

The 2965A Radio Test Set includes RF and LF high performance spectrum analyzers with features that are normally only found on dedicated high performance spectrum analyzers.

RF Spectrum Analysis

The RF spectrum analyzer allows fast high resolution analysis of signals applied to either of the RF inputs over a wide dynamic range including off-air signals. Facilities include flexible frequency level settings, steerable markers for absolute or relative measurement of level or frequency and control of the resolution bandwidth.



The update rate is remarkable for this type of product, allowing real-time measurements on off-air signals.

The tracking generator provides a convenient method of alignment for filters and sub-modules whilst the offset generator facilitates mixer testing.

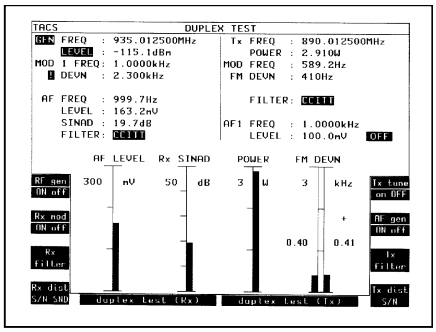
LF Spectrum Analysis

The FFT analyzer allows analysis of audio signals demodulated from RF or via the audio input. Interference and intermodulation products can be analyzed and distortion observed at a range of frequencies. An automatic sweep facility to 20 kHz complements the manual facilities of the FFT.

Comprehensive Audio and Modulation Sources

Three LF generators are provided for audio stimulus along with three modulation sources - enabling the most complex signaling to be generated without the need for external oscillators. These sources can be combined to produce a single audio or modulation source to 100 kHz.

Major signaling protocols are included as standard to reduce the need for external encoders and decoders. User definable tones may be stored in non-volatile memory so that non-standard tone systems can easily be emulated.



Large Bright Display

The 2965A Radio Test Set is designed for intuitive operation. The large, bright, high resolution screen with its 22

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associated soft keys has significant benefits for automated as well as manual testing. From switch on, the 2965A Radio Test Set welcomes the user with features that make radio testing simple, fast and accurate.

Selective Test Modes for Specific Tests

The 2965A Radio Test Set allows a wide range of radio testing.

The DUPLEX mode shows both transmit and receive paths so that any interaction can be observed. If one path needs closer examination, it may be selected without disturbing the other path.

The RF test mode is for testing repeaters, mixers and RF systems including SSB measurements. This mode also gives access to the tracking generator which can be configured to allow RF to IF and IF to RF conversions, doubler and ÷2 analysis. Likewise the AF Test mode provides audio testing when the RF is not required giving access to an audio sweep facility.

Comprehensive Cellular Testing

Testing of cellular and trunked radio is required at many stages in the life-cycle of a radio. For applications ranging from factory production through to repair and customer assurance, the test requirements vary considerably. Simple checks through to a full performance test of all the important radio parameters are required. The 2965A Radio Test Set meets all these demands and is flexible yet easy to operate.

The 2965A Radio Test Set provides 'cell site simulation'. This generates the signaling protocol that the radio would see from the real network. It is then possible to place and receive calls. This activates the receiver and transmitter, so that normal parametric measurements can be made. The signaling may also be verified, permitting faults and errors to be traced before releasing a phone on to the network.

All system options allow 'system definition' so that future changes and new country variants can be defined by the user. This flexibility ensures that the 2965A Radio Test Set can develop with a rapidly expanding market.

Built-in Automatic Tests

There are four built-in test programs, ranging from simple call processing to comprehensive performance testing. Each of the tests may be run in a variety of ways to suit individual requirements. The 2965A Radio Test Set can offer a solution for every application using internally run programs.

Manual Test Mode

A manual testing mode is included, allowing tests to be repeated or varied to identify faults.

Data Displays

Data displays show the messages being sent to and from the radio under test. Corrupted messages are indicated on the display and the screen can be easily downloaded to a printer whenever the need arises.

Programming

The control capabilities and Autorun facilities of the 2965A Radio Test Set benefit users who are automating testing in an attempt to reduce failures. Programs can be written in an interpreted form of BASIC by the user and stored inside the instrument. Additional programs can be downloaded via the RS-232 into the user defined area allowing custom programs to be run. Speed is important in all aspects of testing particularly in automatic control. The 2965A Radio Test Set allows multi-tasking for parallel measurements to be made, further enhancing its speed.

Test Program Generation made easy

GPIB Edit and Runtime Software is a PC based test programming and test executive environment for developers of automatic test applications. It runs under Windows and allows the 2965A Radio Test Set to be programmed using high-level language commands. While providing simple access to its powerful facilities the software offers experienced designers the speed and efficiency benefits of a high-level programming environment. The 2965A Radio Test Set GPIB software driver implements all the control functions. Commands are provided for low level access to the 2965A Radio Test Set as well as the main test modes and measurements. The driver allows remote control of transmitter and receiver testing, off air signaling and general purpose RF and AF testing.

Size and Weight

Not only does the 2965A Radio Test Set pack the performance you would normally see on a bench full of instruments, it weighs in at under 18 kg (39.5 lb) so it is portable when the need arises.

Results Storage

Results may be stored in a number of ways. They may be transferred to the PC compatible memory card or sent via the RS-232 or parallel interface to a printer. The memory card meets the PCMCIA 2 standard for standardization of memory card formats.

Utilities Disk

A collection of PC software utilities is available to aid users in programming the 2965A Radio Test Set.

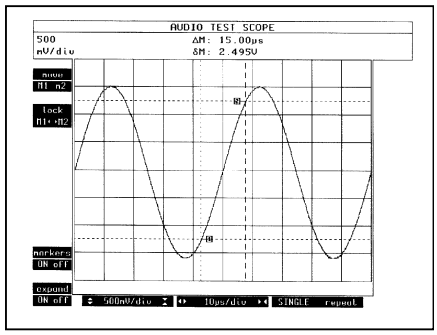
A screen capture facility is available so any screen displayed on the 2965A Radio Test Set can be saved direct to a PC, via the serial port, as a bit map file. These screens can then be imported into documents or retained on a database.

A GPIB command transfer program is also available for use with a suitably equipped PC – this program allows single command transfer, file transfer into internal memory and running of remote control programs.

APPLICATIONS

Base Stations

Many base stations are situated with other transmitters meaning that it is very important to control the problems of out of band radiation and intermodulation products. Most are multi-channel and operate in full duplex, which requires the use of combiners, duplexers and filters. The quality spectrum analyzer with tracking generator will greatly facilitate base station testing. The sensitivity of the receiver also allows remote monitoring and field strength measurements to be taken. The 2965A Radio Test Set is light enough and small enough to be easily carried on-site.

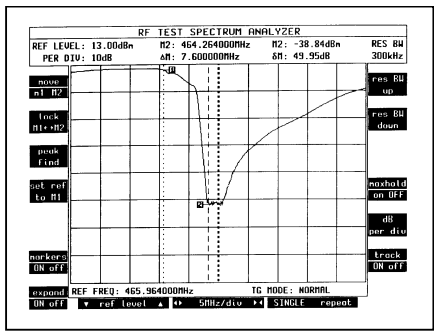


Antenna feeder forward and reverse power, and VSWR measurements can be made using the 2955 Directional Power Head accessories which are compatible with 2965A Radio Test Set.

The software to interface with the Directional Power Head is supplied as standard within the 2965A Radio Test Set.

Comprehensive audio waveform generation and analysis facilities are included for use with modems, speech processors, filters and tone encoders.

The inclusion of a 500 kHz DSO (Digital Storage Oscilloscope) allows audio and demodulated signals to be analyzed, including sequential tones. The multimeter function completes the picture.



Production

Modern production facilities for mobile radio equipment fall into two classes – fully automated and fully de-skilled. In the case of fully de-skilled processes remote control is of primary importance. The use of IEEE-488.2 commands and syntax, multi-tasking and high speeds make the 2965A Radio Test Set ideal. The ease of use of the Autorun capability, the small footprint and the low capital outlay per work station make it ideally suited to this application.

User calibration allows the instrument to be optimized for the operating environmental conditions, i.e. in an

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equipment rack or on the bench. Once run, it will not be necessary to re-run the user calibration unless the operating or ambient temperature changes by more than 5°C.

Quality Assurance

With escalating exports of mobile radio equipment around the world, the need for acceptance testing and quality audits away from the production environment is increasing. It is essential in these situations that the tests be performed with equipment comparable to that used in production. It is often the case, however, that these remote centres are poorly funded and therefore the price/performance of the instrument is a key issue. The 2965A Radio Test Set provides a cost effective solution to meet these needs.

Research and Development

The 2965A Radio Test Set with its spectrum analyzer and high performance signal generator is ideal for use in research and development laboratories. The 2965A provides a complete solution for laboratory needs yet with flexibility to allow field testing and fault location to be easily achieved.

Surveillance

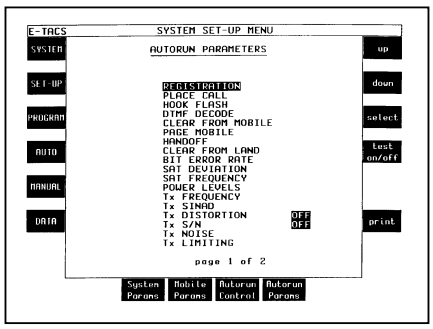
The needs for this market are growing. The basic tools of this trade are a spectrum analyzer and receiver. The 2965A Radio Test Set combines both these requirements.

Military

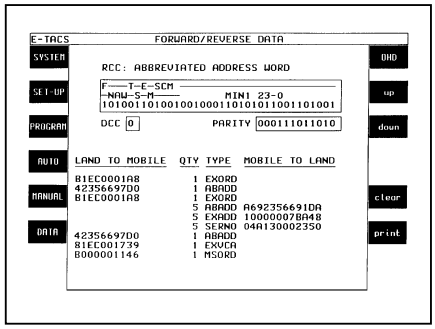
The capabilities of the 2965A Radio Test Set allow a wide range of military AM, FM and SSB radio equipment to be tested, including systems using tone signaling. High power handling capability (up to 150 W) saves the need for external power attenuators when testing vehicle radios.

Analog Cellular

2965A Radio Test Set has optional software for major analog systems which retain the ease of use and comprehensive test capability of the 2960 series.



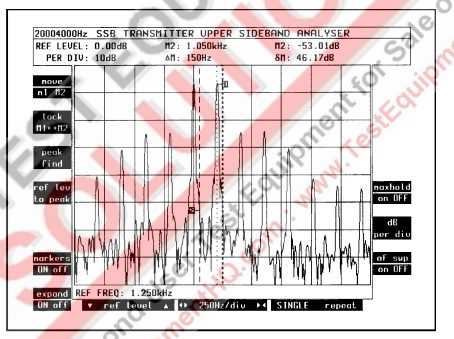
The data display mode allows the sequence of signaling on both the forward and reverse channels to be viewed on the same screen.



A GSM upgrade path is available for the 2965A Radio Test Set allowing effective testing of digital GSM systems.

SSB Option

The SSB option allows the demodulation of SSB transmissions with CW, upper and lower sideband analysis capabilities. The displayed frequency is always the carrier frequency, calculated from the mode (e.g. CW, upper SB and lower SB) and the audio generator frequency. Analysis capabilities include carrier and alternate sideband suppression to 50 dBc and audio analysis via the FFT. Two fully variable audio generators are available to perform two tone measurements.



Specification

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted.
(Applies to version 7.00 and above)

RF Signal Generator

FREQUENCY

Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Resolution
1 Hz

Indication
10 digit display

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
As frequency standard

OUTPUT LEVEL

Range
One-port Dx:
N-Type socket: –135 dBm to –40 dBm
TNC socket: –115 dBm to –20 dBm

Rx Test and two port Dx modes:
N-Type socket: –135 dBm to –7 dBm
(–17 dBm with AM)
TNC socket: –115 dBm to +13 dBm
(+3 dBm with AM)

Resolution
0.1 dB

Indication
4 digits plus sign (dBm, dBμV, μV, mV PD/EMF)

Accuracy
N-Type socket:
±1 dB up to 575 MHz,
±1.5 dB up to 1 GHz for levels above –120 dBm
±1.2 dB 575 MHz to 1 GHz over the temperature range 15 to 35°C.

Carrier On/Off
Keyboard operation, reduces signal generator output to less than –120 dBm

Reverse Power Protection
N-Type socket: With instrument switched on 150 W. Overload indicated by visual and audible warning.

TNC socket: Protection up to 10 W. Reset available on removal of RF power. Excess power indicated by visual and audible warnings.

Output Impedance
50 Ω nominal

VSWR
N-Type socket: better than 1.2 up to 500 MHz; better than 1.3 up to 1 GHz (typically 1.2).
TNC socket: typically 1.3 at 900 MHz.

SPECTRAL PURITY

Residual FM (CCITT weighted)
Less than 6 Hz RMS up to 575 MHz
Less than 12 Hz RMS up to 1 GHz
Residual AM (CCITT weighted)
Less than 0.05% RMS

Harmonics
Better than –30 dBc for levels up to +7 dBm (TNC)
Better than –30 dBc for levels up to –13 dBm (N-Type)

Spurious Signals
Better than –45 dBc for carrier frequencies from 100 kHz to 36 MHz;
Better than –50 dBc for carrier frequencies above 36 MHz

SSB Phase Noise (20 kHz offset)
Better than –114 dBc/Hz up to 575 MHz;
Better than –108 dBc/Hz up to 1 GHz.

RF Carrier Leakage
Less than 0.5 μV PD generated at the carrier frequency in a 50 Ω load by a 2 turn loop 25 mm or more from the case with output level set to below –60 dBm and terminated in a sealed 50 Ω load.

AMPLITUDE MODULATION – INTERNAL

Frequency Range
100 kHz to 400 MHz, useable to 1.15 GHz

AM Depth Range
0 to 99%

Resolution
0.1%

Indication
3 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy[1] (up to 85% AM)
±4% of setting ±1 digit for modulation frequency 1 kHz
±6% of setting ±1 digit for modulation frequencies from 30 Hz to 10 kHz
±8% of setting ±1 digit for modulation frequencies from 10 kHz to 20 kHz

Distortion
Less than 1% at 1 kHz for modulation depths up to 30%, CCITT weighted
Less than 2% for modulation frequencies from 100 Hz to 20 kHz and depths up to 85%

Modulation Frequency
Range: 20 Hz to 15 kHz for carrier frequencies up to 36 MHz; 20 Hz to 20 kHz for carrier frequencies up to 400 MHz.
Resolution: 0.1 Hz below 10 kHz; 1 Hz below 20 kHz.

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AMPLITUDE MODULATION – EXTERNAL

Input impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal AM

Modulation Frequency Range
As internal AM with AC or DC coupling

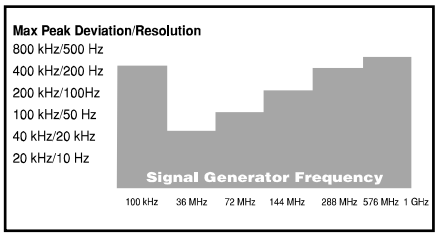
Accuracy
As internal ±2%

Input Sensitivity
1 V RMS for indicated modulation depth

FREQUENCY MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

Maximum Deviation



Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control.

Accuracy[1]
±3% ±1 digit at 1 kHz over the range 15 to 35°C (0.1% per °C outside this range)
Typically ±3% ±1 digit for modulation frequencies from 20 Hz to 5 kHz
Typically ±7% ±1 digit for modulation frequencies from 5 kHz to 20 kHz
Typically ±10% ±1 digit for modulation frequencies from 20 kHz to 75 kHz

Distortion[1]
Less than 0.5% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 kHz to 800 kHz).
Less than 1% for modulation frequencies from 50 Hz to 20 kHz (for deviation 1 kHz to 800 kHz).

Modulation Frequency Range[6]
20 Hz to 20 kHz Mod generators 1, 2, 3 or 20 Hz to 100 kHz Mod generator 4

Resolution
0.1 Hz

FREQUENCY MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal FM

Modulation Frequency Range
DC to 100 kHz (DC coupled)
10 Hz to 100 kHz (AC coupled)

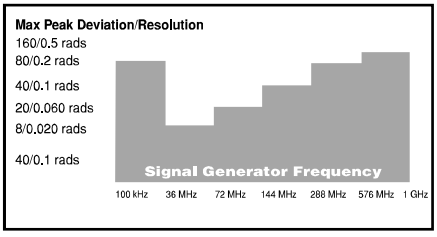
Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2% for frequencies up to 20 kHz

PHASE MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, useable to 1.15 GHz

Maximum Deviation



Indication
4 digits

Setting
Keyboard entry, delta increment/decrement function and rotary variable control

Accuracy
±5% ±1 digit for modulation frequencies from 250 Hz to 3.4 kHz, over the range 15 to 35°C (0.1% per °C outside this range)

Distortion [1]
Less than 1% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 rad to 160 rads)

Modulation Frequency
Range: 250 Hz to 5 kHz

Resolution
0.1 Hz

PHASE MODULATION – EXTERNAL

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
As internal phase modulation

Modulation Frequency Range
250 Hz to 5 kHz

Input Sensitivity
2.828 V pk-pk for indicated deviation

Accuracy
As internal ±2%

INTERNAL MODULATION AND AUDIO SOURCES
Up to 6 tone sources can be assigned as 3 modulation generators and 3 audio tone generators

Modulation Modes
Internal generators may be assigned to AM, FM, ΦM

Audio Voltmeter

Input Impedance
Nominally 1 MΩ in parallel with 100 pF

Frequency Range
DC and 20 Hz to 500 kHz
AC only 20 Hz to 500 kHz
Polarized DC less than 10 Hz

Level Ranges
0 to 10, 0 to 30, 0 to 100, 0 to 300 mV, 0 to 1, 0 to 3, 0 to 10, 0 to 30 V RMS reading (autoranging or fixed)

Level Indication
4 digits and barchart with peak hold

Level Accuracy (DC Coupled)[3] [5]
±2% of reading ±1 mV ± resolution, DC and 100 Hz to 20 kHz
±4% of reading ±1 mV ± resolution, 40 Hz to 100 kHz

Level Accuracy (AC Coupled)[3]
±2% of reading ±1 mV, ± resolution 150 Hz to 20 kHz
±4% of reading ±1 mV, ± resolution 100 Hz to 100 kHz

Residual Noise
100 µV RMS CCITT weighted

Audio Frequency Meter

Range
10 Hz to 500 kHz

Resolution
0.1 Hz from 10 Hz to 5 kHz
1 Hz from 5 kHz to 50 kHz
10 Hz from 50 kHz to 500 kHz

Indication
6 digits

Accuracy
As frequency standard ±1 digit ± resolution

Sensitivity
On barchart greater than 25% FSD (DC coupled)

Audio SINAD Meter

Frequency
1 kHz default. User selectable up to 20 kHz

SINAD Range
5 to 50 dB

Resolution
0.1 dB for readings less than 20 dB
0.2 dB for readings less than 25 dB

Indication
3 digits and barchart with peak hold

Accuracy (bandpass filter selected)
±0.5 dB ± resolution

Sensitivity
100 mV for 46 dB SINAD

Audio Distortion Meter

Frequency
1 kHz default. User selectable up to 20 kHz

Distortion Range
0 to 100%

Resolution
0.1% distortion for readings greater than 1%
0.2% distortion for readings less than 1%

Indication
3 digits and barchart with peak hold.

Accuracy
±5% of reading ± resolution (Bandpass filter selected)

Sensitivity
100 mV for 0.5% distortion

Audio S/N Meter

S/N Range
0 to 100 dB

Resolution
0.1 dB for readings less than 50 dB
0.2 dB for readings less than 70 dB

Indication
3 digits and barchart with peak hold

Accuracy
±0.5 dB ± resolution

Sensitivity
2 V for 60 dB, 200 mV for 40 dB

Audio Oscilloscope

Operating Modes
Single or Repetitive sweep

Frequency Range
DC to 500 kHz
10 Hz to 500 kHz (AC coupled)

Glitch Catching
1 µs minimum

Voltage Ranges
2 mV/div to 20 V/div in a 1, 2, 5 sequence

Voltage Accuracy
±5% of full scale

Timebase
5 µs/div to 10 s/div in a 1, 2, 5 sequence

Timebase Accuracy
As frequency standard

Trigger Mode
Auto trigger

Marker Indication
Level: M1-M2, M2-M1
Time: M1-M2, M2-M1

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Audio FFT Analyzer

Span Widths
50 Hz to 50 kHz in a 5, 10, 25 sequence.
Above 40 kHz signals are attenuated by 80 dB/octave

Graticule
10 Horizontal by 8 Vertical divisions
Can be magnified to full screen

Level Reference (top of screen)
10 mV to 20 V, in a 1, 2, 5 sequence

Level Accuracy
±0.3 dB 100 Hz to 15 kHz; typically ±1 dB 40 Hz to 40 kHz

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Vertical Scaling
1, 2, 5, 10 dB/div

Dynamic Range
60 dB

Max Hold Facility

Audio Sweep facility
DC to 20 kHz

Marker Indication
Level: M1, M2, M1-M2
Frequency: M1, M2, M1-M2

Audio Barcharts

Displays: AF voltage, SINAD, Distortion, S/N.
Vertical Resolution: 1% of full scale
Ranging: Autoranging, range hold or manual selection (up/down), 1, 3, 10 sequence with hysteresis
With peak hold facility

Audio and Modulation Filters

300 Hz Lowpass (±0.1 dB less than 150 Hz, ±0.2 dB, 150-200 Hz relative to 100 Hz).
300 Hz to 3.4 kHz Bandpass (±0.4 dB, 400 to 2100 Hz relative to 1 kHz).
5 kHz Lowpass (±0.3 dB at <3 kHz relative to 1 kHz)
20 kHz Lowpass ±0.3 dB at <12 kHz, typically –0.9 dB at <15 kHz and –3 dB at 20 kHz relative to 1 kHz
CCITT Psophometric
C-MESSAGE
See also under Environmental/User Calibration

Multimeter

Input Terminals
3 x 4 mm, 'Volt/Ohm', 'Current' and 'Common'

Maximum Input Voltage
375 V with respect to instrument chassis

VOLTMETER

Voltage Range
0 to 300 V, 0 to 30 V, 0 to 3 V, 0 to 300 mV, Terminals, 'Volt/Ohm' and 'Common', maximum crest factor 3:1 at range full scale

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Input Impedance
Nominally 6 MΩ in parallel with 100 pF

Resolution
0.1% of FSD

Accuracy (5)
±3% of reading ±1 mV ±1 digit
See also under Environmental/User Calibration

Indication
4 digits and barchart with peak hold

AMMETER

Current Range
0 to 1 A and 0 to 10 A

Frequency Range
Polarized DC or 40 Hz to 1 kHz

Resolution
1 mA below 1 A; 10 mA below 10 A

Accuracy
±5% of reading ±1 mA ±1 digit

Indication
4 digits and barchart with peak hold

RESISTANCE METER

Resistance Ranges
100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ

Resolution
1 Ω below 1 kΩ or 3 digits

Accuracy (5)
±5% of reading ±1 Ω ±1 digit
Continuity Test continuous tone if reading is less than 10 Ω

Indication
4 digits and bar chart with peak hold

RF Frequency Meter

Range
100 kHz to 1 GHz

Resolution
1 Hz or 10 Hz selectable

Indication
Up to 10 digits

Accuracy
As Frequency Standard ±2 Hz ± resolution

Dynamic Range (Auto tuned)
As RF Power Meter (broadband)

Frequency Range (Auto tuned)
10 MHz to 999.9 MHz

Sensitivity
Manual tuned: –100 dBm (TNC) dependent on receiver bandwidth in off air test mode

Offset Frequency Range
±1 MHz dependent on receiver bandwidth

RF Power Meter (Broadband)

Frequency Range
100 kHz to 1 GHz

Dynamic Range (Auto tuned)
10 mW to 150 W (N-Type), 100 µW to 0.5 W (TNC)

Power Reading
True mean power

Indication Units
Watts

Resolution
Better than 1%

Indication
3 digits and barchart with peak hold

Accuracy(5)
100 kHz to 500 MHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type).
±10% (0.4 dB), 20 mW to 150 W (N-Type).
±12% (0.5 dB), 200 µW to 50 mW (TNC).
500 MHz to 1 GHz:
±12% (0.5 dB), 20 mW to 150 W (N-Type).
±15% (0.6 dB), 200 µW to 50 mW (TNC).
100 kHz to 1 GHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type) +10% (0.4 dB).
1 mW to 50 mW (TNC) for ambient temperatures in the range 15 to 35°C.
See also under Environmental/User Calibration

Maximum Safe Continuous Rating
N-Type: 50 W
TNC: 0.5 W, overload protected to 10 W

Intermittent Rating
N-Type: 150 W for limited periods, typically two minutes at 20°C. Typical off to on ratio is 6:1.
Overload indicated by audible and visual warning

RF Power Meter (Selective)

Frequency Range
100 kHz to 1 GHz

IF Bandwidth
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Dynamic Range (Manual tuned)
0 dBm to +50 dBm (110 kHz IF bandwidth) (N-Type
–90 dBm to +20 dBm (110 kHz IF bandwidth) (TNC)

Power Reading
Average

Indication Units
dBm

Resolution
0.1 dB

Indication
3 digits + barchart with peak hold

Accuracy (5)
Typically ±2.5 dB N-Type & TNC
See also under Environmental/User Calibration

RF Spectrum Analyzer

Frequency
Range: 100 kHz to 1 GHz, useable from 30 kHz to 1.05 GHz

Spans
500 Hz/div to 100 MHz/div, in a 1, 2, 5 sequence

Resolution Bandwidth
300 Hz to 300 kHz in a 1, 3, 10 sequence and 3 MHz (automatically selected according to span and manually selectable).
Video bandwidth – fixed at 3 kHz

Filter Shape
Nominally 3 dB/60 dB, 1:11 (300 Hz to 30 kHz bandwidth)

Reference Level (top of screen)
–100 dBm to +70 dBm

On Screen Dynamic Range
80 dB

Vertical Resolution
0.5 dB on 10 dB/div, 0.05 dB on 1 dB/div

Level Accuracy (5)
Typically ±2.5 dB
See also under Environmental/User Calibration

Intermodulation Distortion
Less than 80 dB for 2 signals on screen at reference level

Sweep Speeds
Optimum sweep speed selected according to span and resolution bandwidth

Modes
Single sweep and continuous

Graticule
10 horizontal by 8 vertical divisions

Expanded Mode
Can be made to occupy full screen for high definition

Markers
M1 and M2

Indication
Level: M1, M2, M1-M2
Frequency: M1, M2, M1-M2

TRACKING GENERATOR
Available in RF TEST mode

Frequency Range
100 kHz to 1 GHz

Level Range
–135 dBm to +13 dBm

Offset Tracking
Allows testing of mixers, IFs, fundamental and 2nd harmonic analysis (up, down, x2, ÷2)

Modulation Analyzer

Dynamic Range (Auto tuned)
As RF Power Meter (Broadband)

Sensitivity (Manual tuned)
N-Type –30 dBm (110 kHz IF bandwidth)
TNC –50 dBm (110 kHz IF bandwidth)
TNC (off-air test mode) –101 dBm (2 µV 10 dB SINAD in 30 kHz IF bandwidth and CCITT weighting)

Demodulation
Accuracy maintained on signals greater than –60 dBm

Receiver Bandwidths
300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

Demodulation Filters
As audio analyzer plus 5 kHz lowpass (+0.3 dB at less than 3.4 kHz relative to 1 kHz)

Audio Output
Available in to an internal loudspeaker, demodulated output or accessory socket for external loudspeaker or headphones.

Switching Speed
Nominally less than 1 ms channel to channel up to 50 MHz apart, settling to within 1 kHz of final frequency

Demodulated Output
Nominal output impedance less than 10 Ω. Output

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voltage is range dependent (2 V peak at top of range).

Squelch
A manual squelch control is provided with a variable threshold

AMPLITUDE MODULATION

Frequency Range
100 kHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

AM Depth Range
0 to 99.9%

Resolution
0.1% AM

Indication
3 digits and barchart with peak hold

Accuracy (up to 85% AM)[1] [5]
±% of reading, ±1% AM, 250 Hz to 5 kHz.
Typically ±5% of reading, ±1% AM, 50 Hz to 15 kHz.

Demodulation Distortion[1]
Less than 1% at 1 kHz, CCITT weighted

Residual AM
Less than 0.1% AM, CCITT weighted

FREQUENCY MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
20 Hz to 20 kHz

Deviation Range
0 to 100 kHz

Resolution
10 Hz below 10 kHz deviation; 100 Hz below 100 kHz deviation

Indication
3 digits and barchart with peak hold

Accuracy [1] [3] [5]
±3% ± resolution for modulation frequency of 1 kHz
±5% ± resolution for modulation frequencies from 100 Hz to 15 kHz

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted

Residual FM
Less than 25 Hz RMS CCITT weighted

PHASE MODULATION

Frequency Range
1 MHz to 1 GHz

Modulation Frequency Range
250 Hz to 5 kHz

Deviation Range
0 to 20 rads

Resolution
0.01 rads

Indication
3 digits and barchart with peak hold

Accuracy [1] [3] [5]
±5% ± resolution

Demodulation Distortion[1]
Less than 0.5% at 1 kHz, CCITT weighted

Audio Generators

See section on modulation generators for interaction of audio and modulation generators.

FREQUENCY

Range[6]
1 Hz to 20 kHz AF Gens 1, 2 & 3 or
1 Hz to 100 kHz AF Gen 4

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
6 digits

Resolution
0.1 Hz

Accuracy
As frequency standard

LEVEL

Range
0.1 mV to 5 V RMS (maximum AF output 7 V peak, all generators combined)

Setting
Keyboard entry, delta increment/decrement function and rotary control

Indication
4 digits

Resolution
0.1 mV

Accuracy
±3% ±1 digit, 250 Hz to 5 kHz
±5% ±1 digit, 10 Hz to 20 kHz
±10% ±1 digit, 20 kHz to 75 kHz

Output Impedance
Nominally 5 Ω

Protection
Maximum applied voltage 50 V

SIGNAL PURITY

Distortion[2]
Less than 0.5% at 1 kHz measured in a 30 kHz bandwidth
Less than 1% from 20 Hz to 20 kHz measured in an 80 kHz bandwidth
Typically 0.1% for levels greater than 100 mV

Residual Noise
Less than 50 µV RMS (CCITT weighted)

DC Offset
Less than 10 mV

Signaling Encoder/Decoder

Sequential tones functions
Encodes and decodes up to 40 tones.
CCIR, ZVEI, DZVEI, EEA, EIA or user defined.
Any of the tones may be extended.
Continuous, burst and single step modes available.

User defined tones
Up to three frequency plans may be defined and stored within the 2965 for sequential tones.
Any of the standard tone frequency plans may be copied to user defined and modified.
Tone length 10 ms to 1 s.
Extended tone length 100 ms to 10 s.

CTCSS tones mode
Standard tone frequencies may be selected from a menu

DTMF Encoder/Decode
Generation and decode of DTMF tones, displaying Hi/Lo frequencies, frequency error, timing information and twist.

DCS Encode/Decode
Generation and decoding of digitally coded squelch

POCSAG generator
Generation of POCSAG code CCIR No.1
Rec 584. Bit rates from 400 to 9600 bit/s

Audio Monitor

Audio and demodulation signals and audio signals may be monitored via the internal loudspeaker or via the accessory socket output or BNC socket on the rear panel

SSB Option

SSB Tx

Frequency, Range and meter accuracy	– as RF frequency
Power, level and meter accuracy	– as Broadband power
Detection Range	– 100 µV to 150 W
AF Demod range	– 10 Hz to 5 kHz
Demod distortion	– <2% @ 1 kHz, CCITT weighted
Carrier and Alternate s/band suppression	– Better than –50 dBc
Sideband/CW Analyzer	– max 5 kHz full span frequency range
Spectrum Analyzer	– as RF spectrum analyzer
Audio Generator	– two – as audio generator
Sideband Selection	– LSB, USB, CW

SSB Rx

Sideband Generator	– as RF Gen (AM mode)
Offset measurement	– to 0.1 Hz resolution
SINAD	– as SINAD meter
Distortion	– as Distortion meter

Note: No audio is available in SSB option

General Features

INTERFACES

Keyboard and Display
Logical color coded keyboard with bright high resolution CRT

GPIB
Full control of all major instrument functions via the GPIB interface
Flexibility is further enhanced by IFR's implementation of IEEE-488.2.

Capability
Complies with the following subsets as defined in IEEE-488.1-1978:- SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, E1.

Serial
Serial interface is provided for connection of RS-232 for instrument remote control. 9 Way socket. Control language is based on IEEE P1174.

Parallel Printer
Connector 25 way female D-Type. Provision made for graphics screen dump. A selection of printer drivers are included.

Accessory Socket
Allows the connection of various optional accessories.
With suitable adapters is compatible with most 2955 series accessories.

Memory Card
Meets PCMCIA2/JEIDA – 4 standard. The memory card facility allows the storage of results and set ups.

Video Output
Color, compatible with most VGA monitors.
15 way Sub Miniature D Type.

Frequency Standard

Internal Frequency Standard Output

Frequency
10 MHz

Level
Nominally 2 V pk-pk

Output Impedance
Nominally 50 Ω

Temperature Stability
Better than 5 in 10^8, 5 to 50°C

Ageing Rate
Better than 1 in 10^7 per year, after 1 month continuous use

Warm Up Time
Less than 10 minutes to within 2 in 10^7 at 20°C

External Frequency Standard Input

Frequencies
1, 2, 5 and 10 MHz

Level
From 1 V pk-pk to 5 V pk-pk

Input Impedance
Nominally 1 MΩ in parallel with 40 pF

Power Requirements

AC supply

Voltage
88 V to 132 V and 188 V to 265 V

Supply frequency
45 Hz to 65 Hz

Power
Nominally 135 W, 260 W maximum, for future options

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Electromagnetic Compatibility

Conforms with the protection requirements of Council directive 89/336/EEC.
Complies with the limits specified in the following standards:

EN55011 Class B	CISPR11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

Safety

Complies with IEC 1010-1, BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Environmental

Rated Range Of Use
0 to 50°C and up to 95% relative humidity at 40°C.

User Calibration

User calibrations are provided to maintain high accuracy for any ambient temperature (e.g. in ATE racks or in field measurements). Having allowed the instrument to stabilize, running the user calibrations optimizes the performance at that temperature.
A change in temperature of 5°C from the calibration temperature affects readings as below. These figures are provided as a guide to typical performance.
Typical variations are as follows for a 5°C change in temperature.

Power Meter:	Broadband	2%
	Selective	0.5 dB
Spectrum Analyzer Level		0.5 dB
Audio Analyzer & Modulation Filters		
	Audio Voltage	0.4%
	Demod depth & deviation	0.4%
Multimeter:	Voltage	0.5%
	Current	0.5%

STORAGE AND TRANSPORT

Temperature
–40 to +70°C

Altitude
Up to 2500 m (pressurized freight at 27 kPa differential)

Internal Test Software

OPTION 10 NMT CELLULAR SOFTWARE

NMT450	NMT900
Benelux	NMTF
Austria	Spain
Malaysia	Indonesia
Saudi 1	Saudi 2
Thailand	Oman
Tunisia	Hungary
Poland	Russia
Czech	Bulgaria
Slovenia	Turkey

USER DEFINED NMT

OPTION 11 AMPS CELLULAR SOFTWARE

E-AMPS	N-AMPS

USER DEFINED AMPS

OPTION 12 TACS CELLULAR SOFTWARE

E-TACS	TACS-2
C-TACS I	C-TACS II
J-TACS	N-TACS

USER DEFINED TACS

OPTION 13 MPT1327 TRUNKING SOFTWARE

Band III	JRC
UK Water	Hong Kong
Autonet	AMT
Madeira	NL-TRAXYS
NZ MPT1327	PH-INDO

USER DEFINED MPT

OPTION 14 PMRTEST SOFTWARE
USER DEFINED PMR for FM radios

General Features (Systems)

Test Modes
Auto Test/Manual Test

Auto Test Programs
Call Processing Only
Call and RF Testing
Brief Testing
Comprehensive Testing
User Defined Test

Parametric Auto Test Routines

AF Frequency	AF Level
FM Deviation	Mod Frequency
Rx Distortion	Rx Expansion
Rx Sensitivity	Rx SINAD
Rx S/N	Tx Compression
Tx Distortion	Tx Frequency
Tx Level	Tx Power Level
Tx Limiting	Tx Mod Level
Tx Noise	Tx SINAD
Tx S/N	SAT Deviation
SAT Frequency	ST Duration
ST Frequency	ST Deviation
Data Deviation	DSAT Deviation

Signaling Auto Test Routines
Registration/Roaming Update
Place Call
Clear From Mobile
Page Mobile
Handoff
Clear From Land
Hook Flash
DTMF Decode
Data Performance
PTT On
PTT Off

Auto Test Pause Modes
Pause Manual Only
Pause On Failure
Pause Always

DIMENSIONS AND WEIGHT
Excluding handle, feet and covers.

Height	*Width*	*Depth*
177 mm (6.9 in)	370 mm (14.5 in)	540 mm (21.2 in)

Including handle, feet and covers.

Height	*Width*	*Depth*
203 mm (7.9 in)	420 mm (16.5 in)	600 mm (23.6 in)

Weight
Less than 18 kg (39.5 lb)

NOTES
(1) At low modulation levels the residual AM/FM may become significant.
(2) At low audio levels the residual noise may become significant.
(3) Audio and Modulation filter passband errors not included.
(4) Typical performance figures are non-warranted.
(5) Refer to USER CALIBRATION section.
(6) Either 3 modulation plus 3 audio generators up to 20 kHz or 1 modulation or 1 audio generator to 100 kHz.

Versions and Accessories

When ordering please quote full ordering number information

Ordering numbers	*Versions*
2965A	Radio Test Set
	Options
Option 01	French Language Version
Option 02	Spanish Language Version
Option 03	German Language Version
Option 09	SSB receiver option
Option 10	NMT Cellular Radio option*
Option 11	AMPS Cellular Radio option (including N-AMPS)*
Option 12	TACS Cellular Radio option (including N-TACS)*
Option 13	MPT 1327/MPT 1343 Trunked Radio option*
Option 14	PMRTEST for FM

* Specify which analog cellular option (options 10 to 14) is required at time of ordering

Contact your local sales outlet for details of availability of options

Option 21	GSM Hardware and Software Upgrade, P-GSM, E-GSM, User Defined GSM
	Supplied with
	AC Supply lead
	Operating Manual
	Multimeter Lead Kit (Two 4 mm leads to test points)
	Accessories
54421/001	BNC Telescopic antenna
54431/023	20 dB AF attenuator (BNC)
54112/158	Hard Transit Case
54112/157	Soft Carrying Case
54127/310	Rack Mounting Kit
59000/189	Memory Card (128 k)
54411/052	Impedance Matching Unit (requires 46884/645 Accessory socket adapter)
46884/645	Accessory socket adapter (for use with 2955 accessories)
46884/646	Accessory Socket 'Y' adapter
46884/560	Parallel Printer Interface Cable
46884/649	Serial port to PC Cable 25 way
46884/650	Serial port to PC Cable 9 way
43129/189	GPIB Cable
43130/596	Coaxial cable N-Type(m) to TNC(m) (double screened)
54311/095	Coaxial cable N-Type(m) to N-Type(m) (1 metre)
54311/071	TNC(m) to BNC(f) adapter
54311/092	N-Type(m) to BNC(f) adapter
52388/900	1 GHz Active Probe
54441/012	Power supply for probe 52388/900
B27033	GPIB Edit and Runtime Software, Single User, Dongled.
B27071	2965A Radio Test Set GPIB Software Driver
46880/056	Service manual
Option 21	GSM Hardware and Software Upgrade Note that this option is only available as a retrospective upgrade. To order a complete Radio Test Set, with GSM capability, see 2966A.
	Service Support
W2	Two year warranty
W3	Three year warranty

Contact your local sales outlet for availability of these and other service plans

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